



A Project to Map and Monitor Baldcypress Forests in Coastal Louisiana, using Landsat, MODIS, and ASTER Satellite Data

Presented to the 2012 Louisiana RS/GIS Workshop by:
Joseph Spruce, Computer Sciences Corporation (CSC)
Steven Sader, University of Maine
James Smoot, CSC

Introduction



- Cypress swamp forests of Louisiana offer many important ecological and economic benefits
 - wildlife habitat, forest products, storm buffers, water quality, and recreation
- Such forests are also threatened by multiple factors
 - subsidence, salt water intrusion, sea level rise, persistent flooding, hydrologic modification, hurricanes, insect and nutria damage, timber harvesting, and land use conversion
- Unfortunately, there are many information gaps regarding the type, location, extent, and condition of these forests
- Better more up to date swamp forest mapping products are needed to aid coastal forest conservation and restoration work (e.g., through the Coastal Forest Conservation Initiative or CFCI)
- In response, a collaborative project was initiated to develop, test and demonstrate cypress swamp forest mapping products, using NASA supported Landsat, ASTER, and MODIS satellite data

Research Objectives



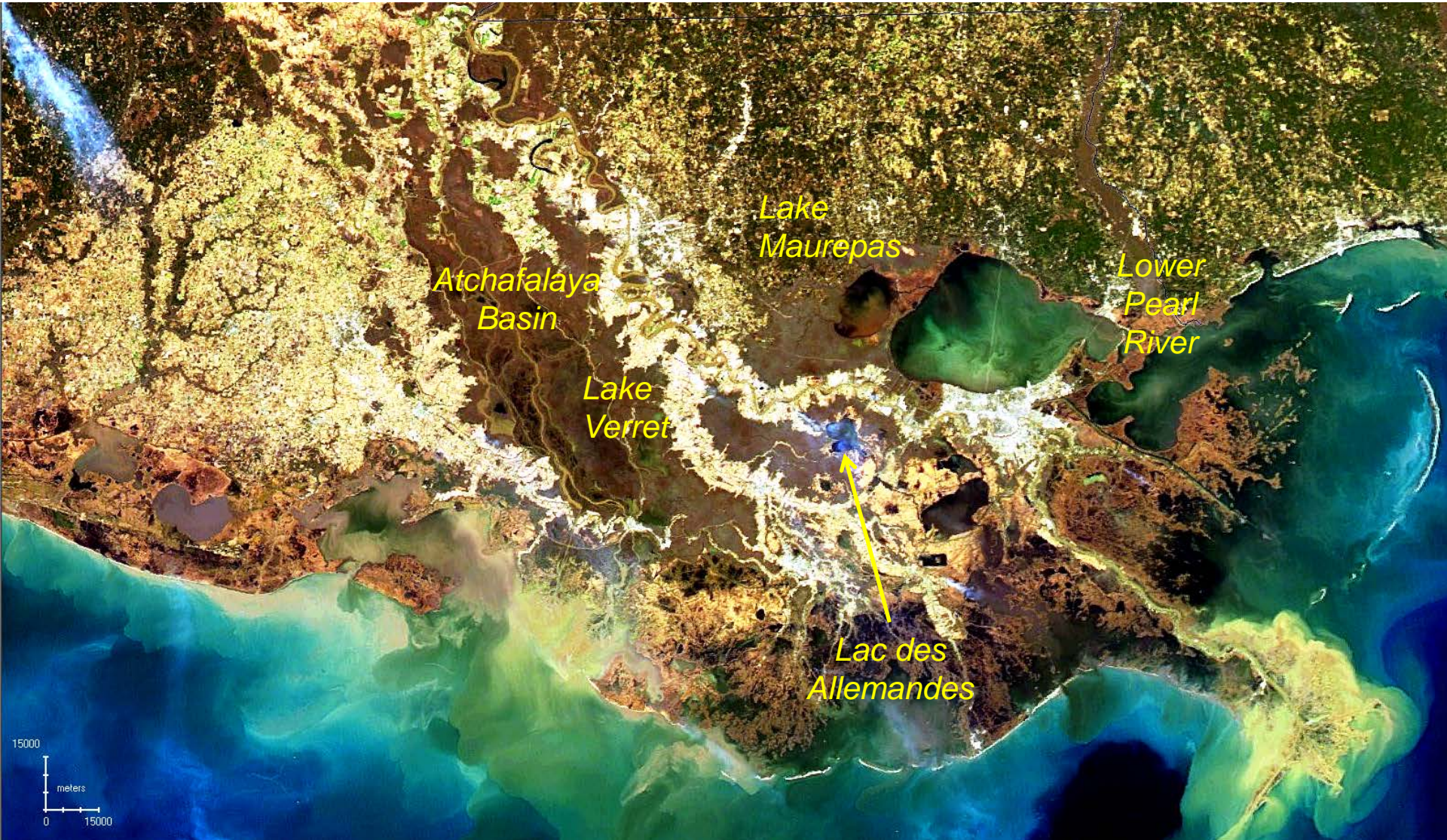
Develop, test, and demonstrate:

- Landsat and ASTER data for computing new cypress forest classification products
- Landsat, ASTER, and MODIS satellite data for detecting and monitoring swamp forest change

Study Area Location



MODIS True Color Image – Acquired December 19, 2003



Data Acquisition



Primary Data

- Landsat data – acquired from early 1970s onwards
- ASTER data – acquired from 1999 onwards
- MODIS NDVI data – 2000 onwards

Ancillary Data

- Historical vertical and oblique aerial photography
- High resolution commercial satellite data
- Field survey data (photos, GPS, notes)



Cypress classifications

- Cover type classification from ISODATA clustering
- Canopy cover classification with Sub-Pixel classifier software
- Derived from fall 2009 Landsat data

Swamp forest change products

- ISODATA clustering of NDVI data stack for 8 dates from 1972-2010
- Swamp forest change isolated with 1972 swamp forest mask

MODIS forest change

- MODIS data temporally processed using Time Series Product Tool (TSPT) and Phenological Parameter Estimation Tool (PPET) software developed at NASA Stennis Space Center
- Percent change in NDVI products are computed by comparing current and historical “baseline” NDVI



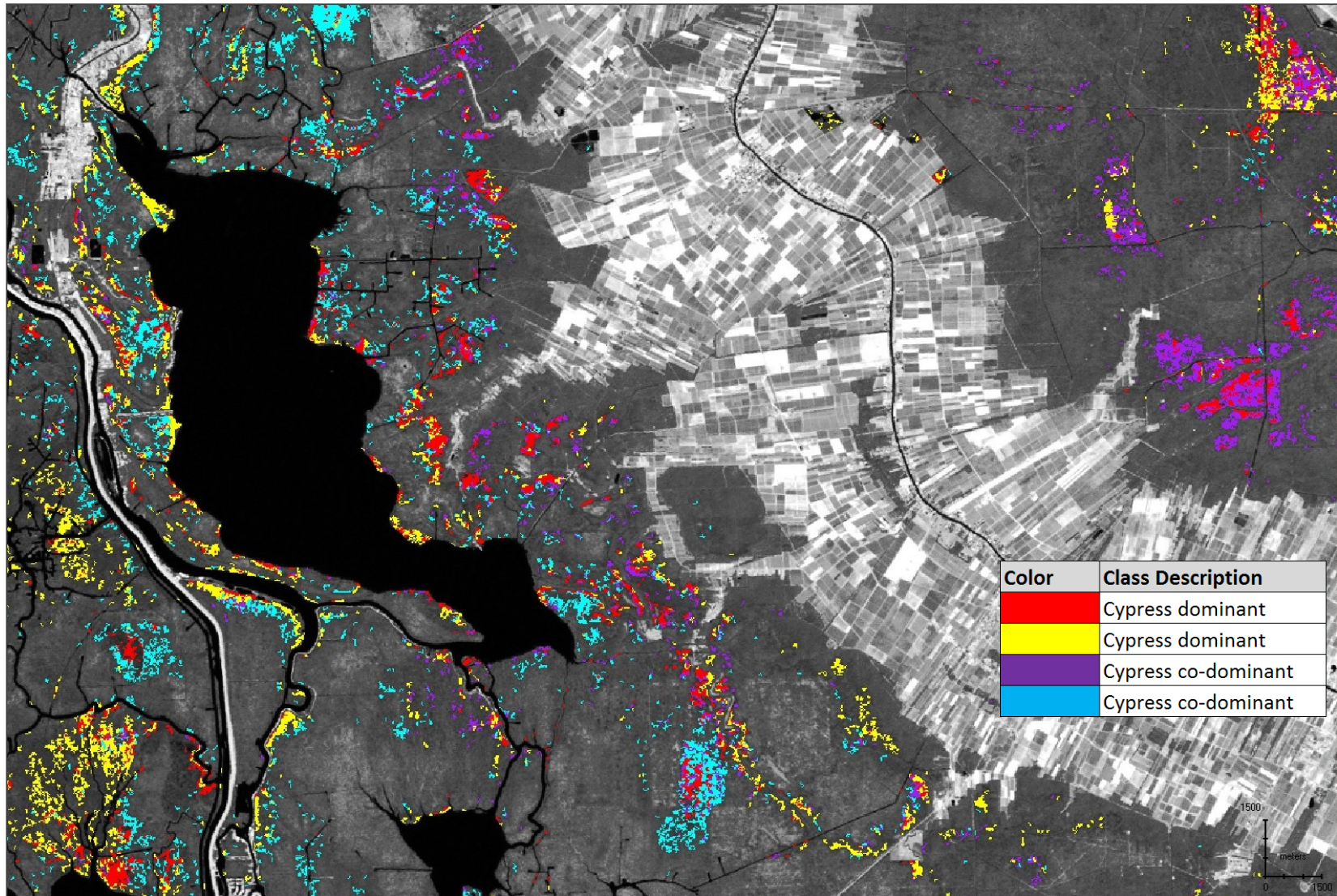
Series 1 - Cypress Forest Classification Products

Landsat Classification of Cypress Forest Types

Stennis Space Center



Results for Lake Verret, Louisiana From Landsat Data Acquired 10-20-2009

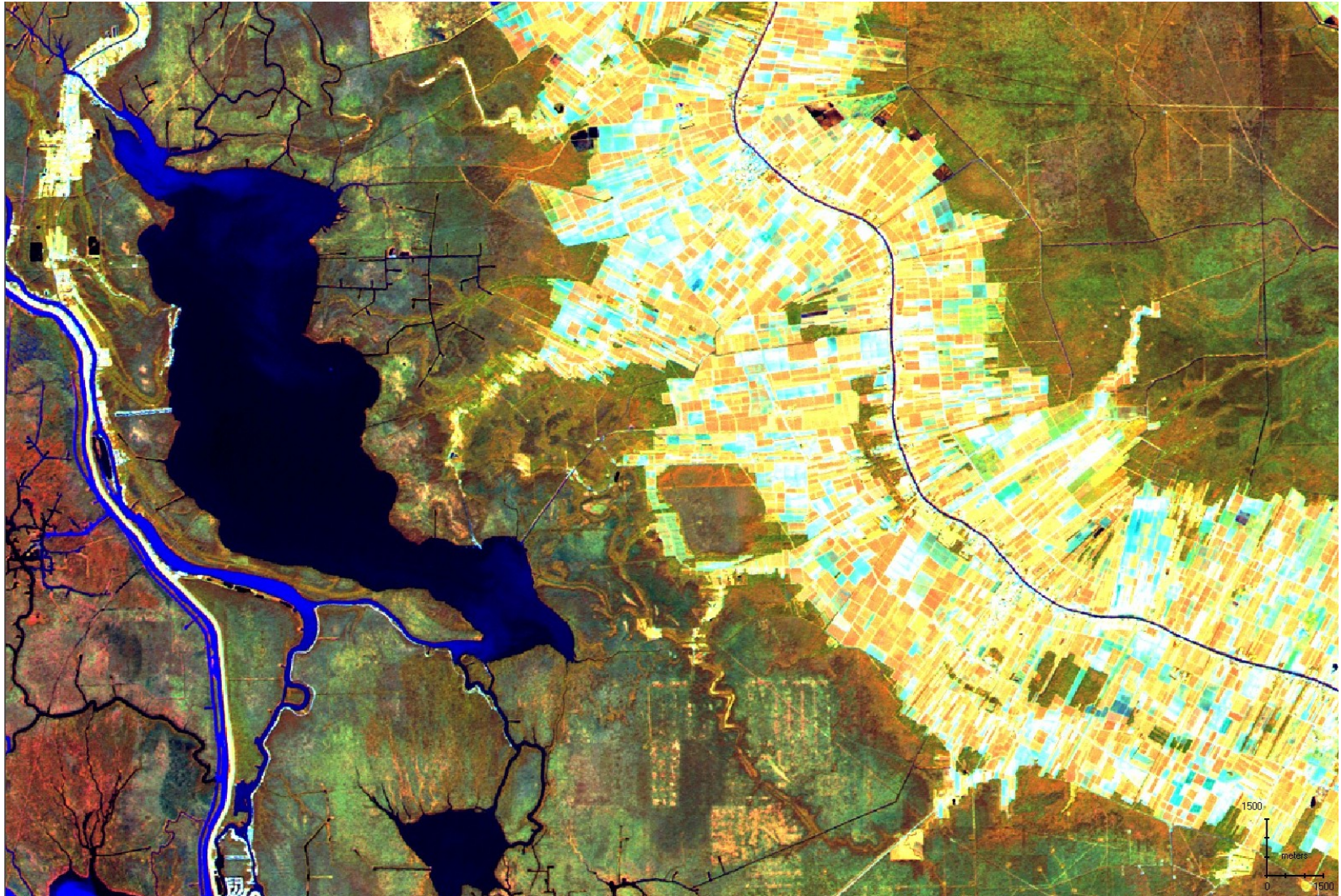


Landsat False Color RGB Acquired 10-20-2009

Stennis Space Center



Cypress Forest Foliage in Chocolate Tones – Water Tupelo in Leaf Off State

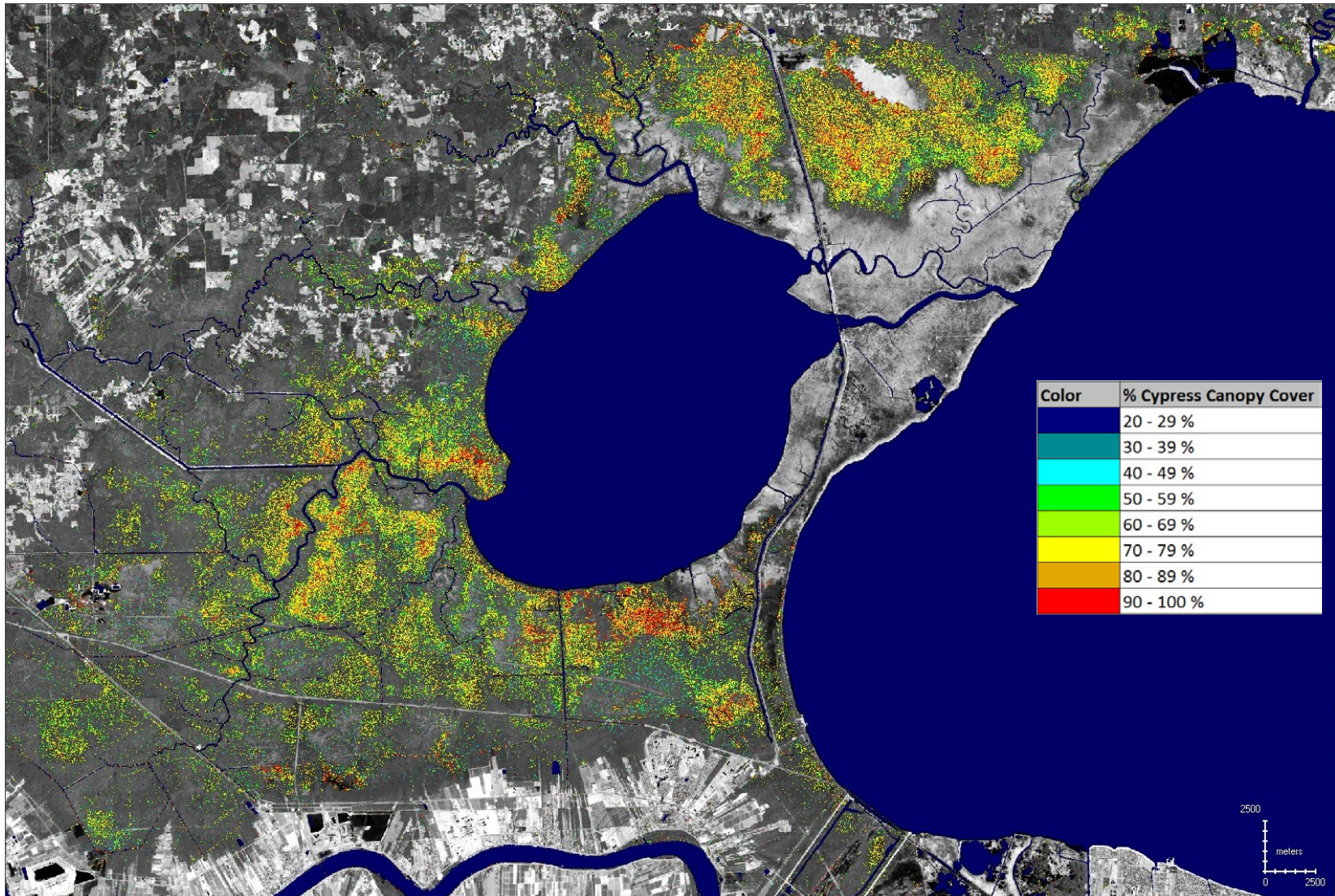


Cypress Forest Canopy Cover Classification from Landsat Data

Stennis Space Center



Results for Lake Maurepas, Louisiana From 10-20-2009 Landsat Scene

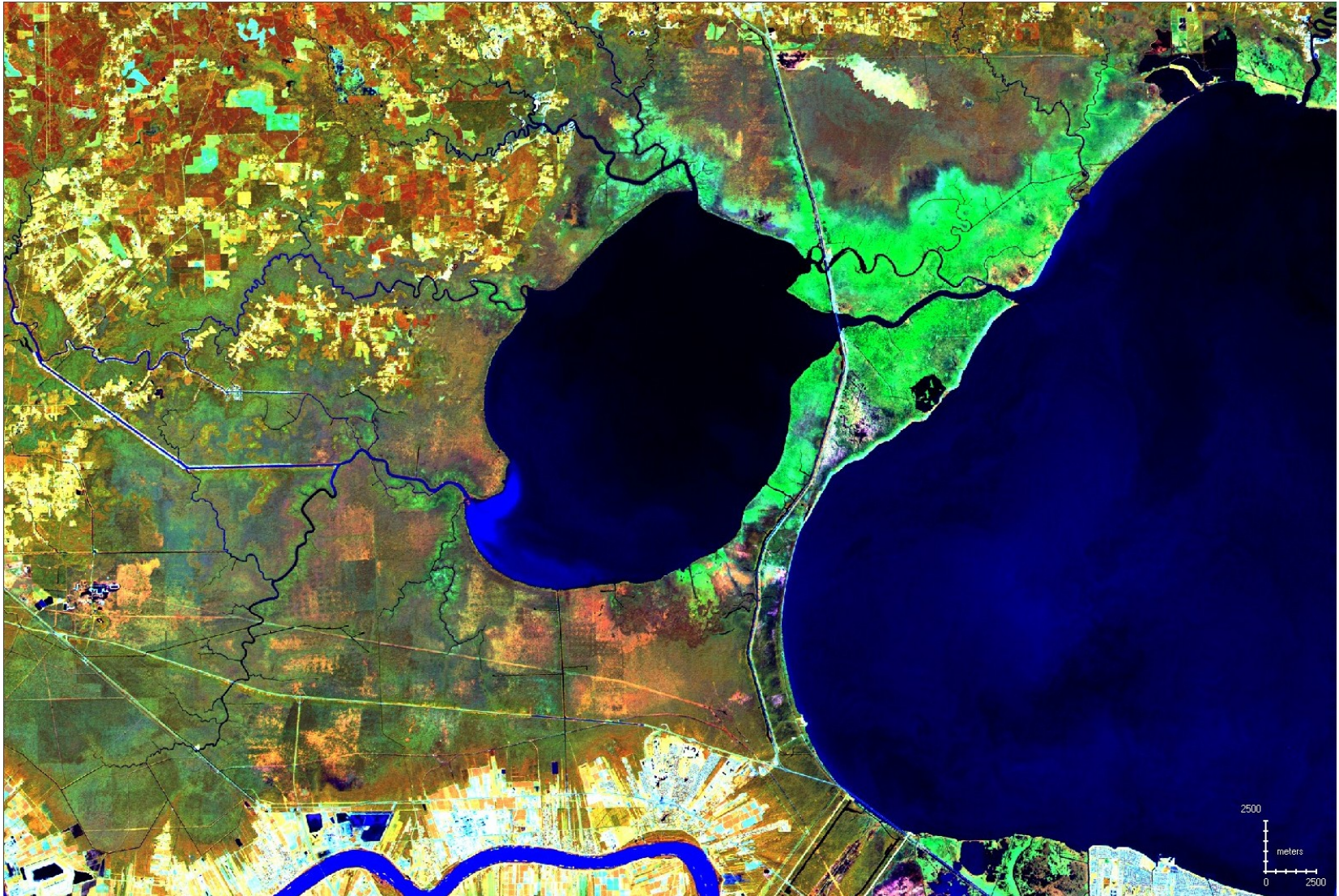


Cypress Forest Canopy Cover Classification from Landsat Data

Stennis Space Center



Cypress Forest Foliage in Chocolate Tones – Water Tupelo in Leaf Off State

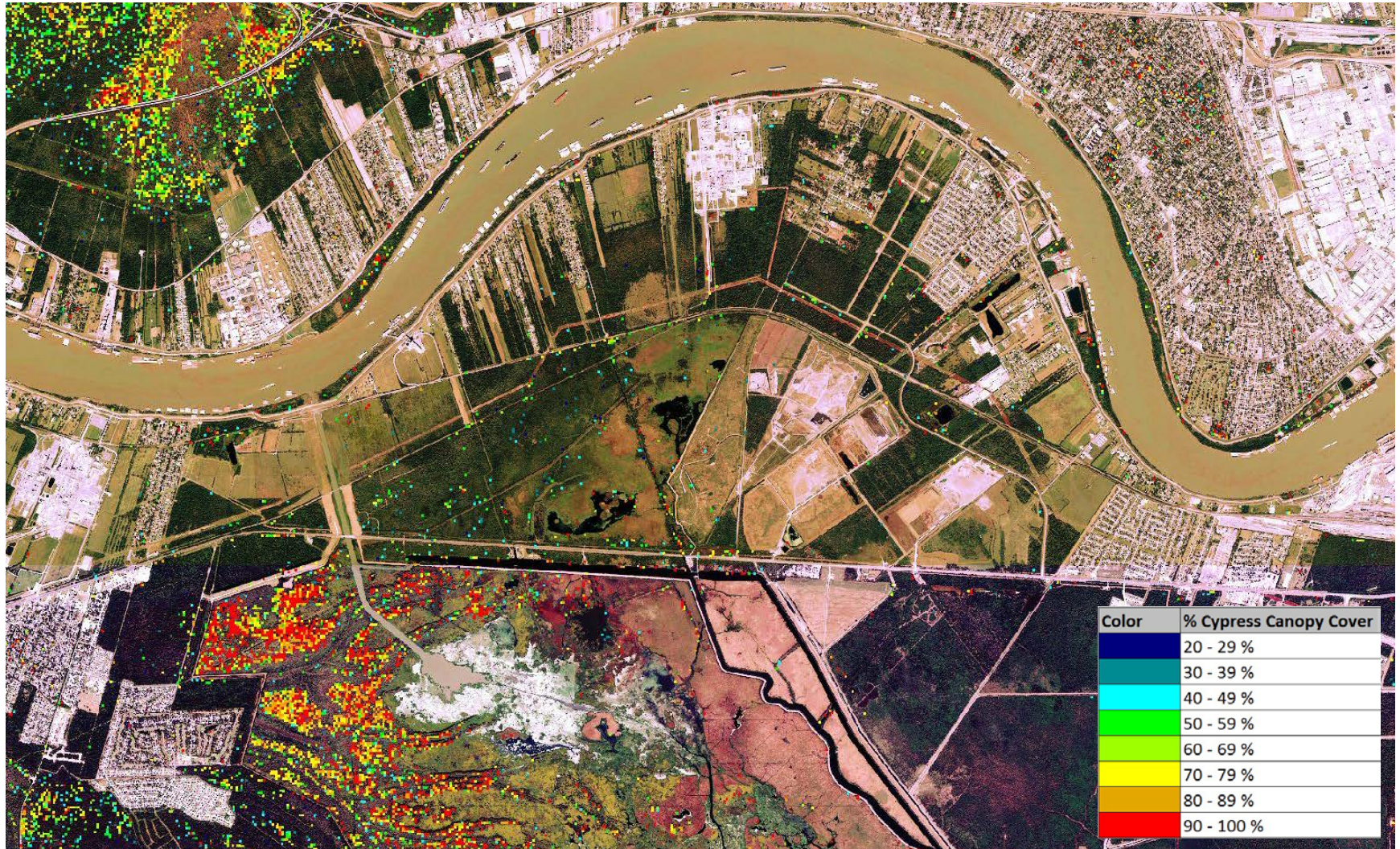


Landsat Classification of Cypress Forest Canopy Cover in 2009

Stennis Space Center



Results for Boutte, Louisiana Draped over 2006 QuickBird True Color RGB



QuickBird True Color Image from October 6, 2006

Stennis Space Center



Cypress Forest in Peak Fall Red Brown Tones





Series 2 – Swamp Forest Change Products from Landsat NDVI Data

Classification of Swamp Forests From 1972 Landsat MSS Data

Stennis Space Center



Results for New Orleans, Louisiana Using Landsat Data from 10-1-1972



False Color RGB from Landsat MSS Data Acquired 10-1-72

Stennis Space Center



Swamp Forests Appear to Be Largely Leaf Off and Flooded

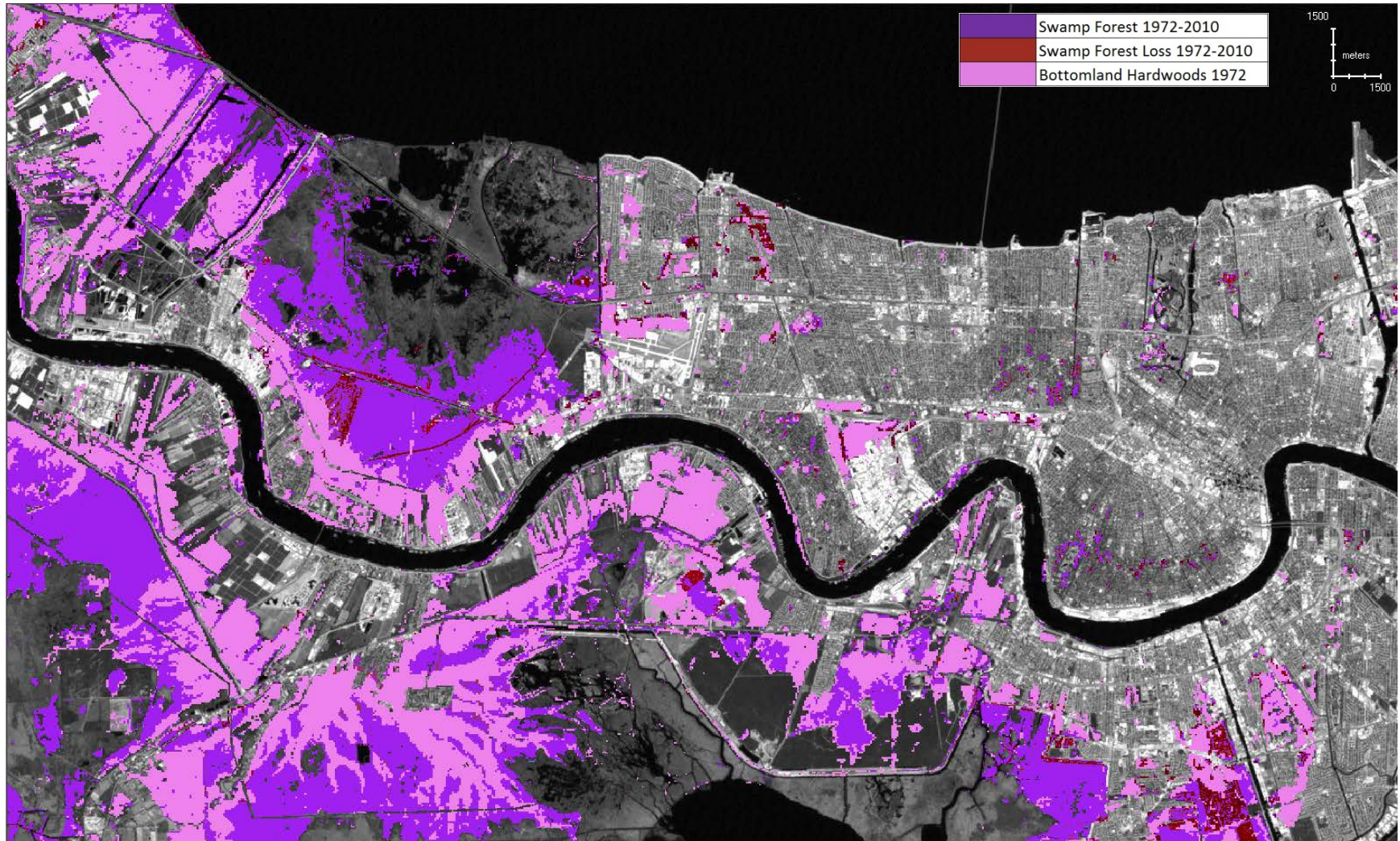


1972 – 2010 Swamp Forest Change Based on Landsat Data

Stennis Space Center



Forest Change Shown in Red Tones – Only Swamp Forest Change Shown



False Color RGB Image from Landsat TM Data Acquired 10-7-2010

Stennis Space Center



Most Swamp Forest Change in This Area is From Urbanization





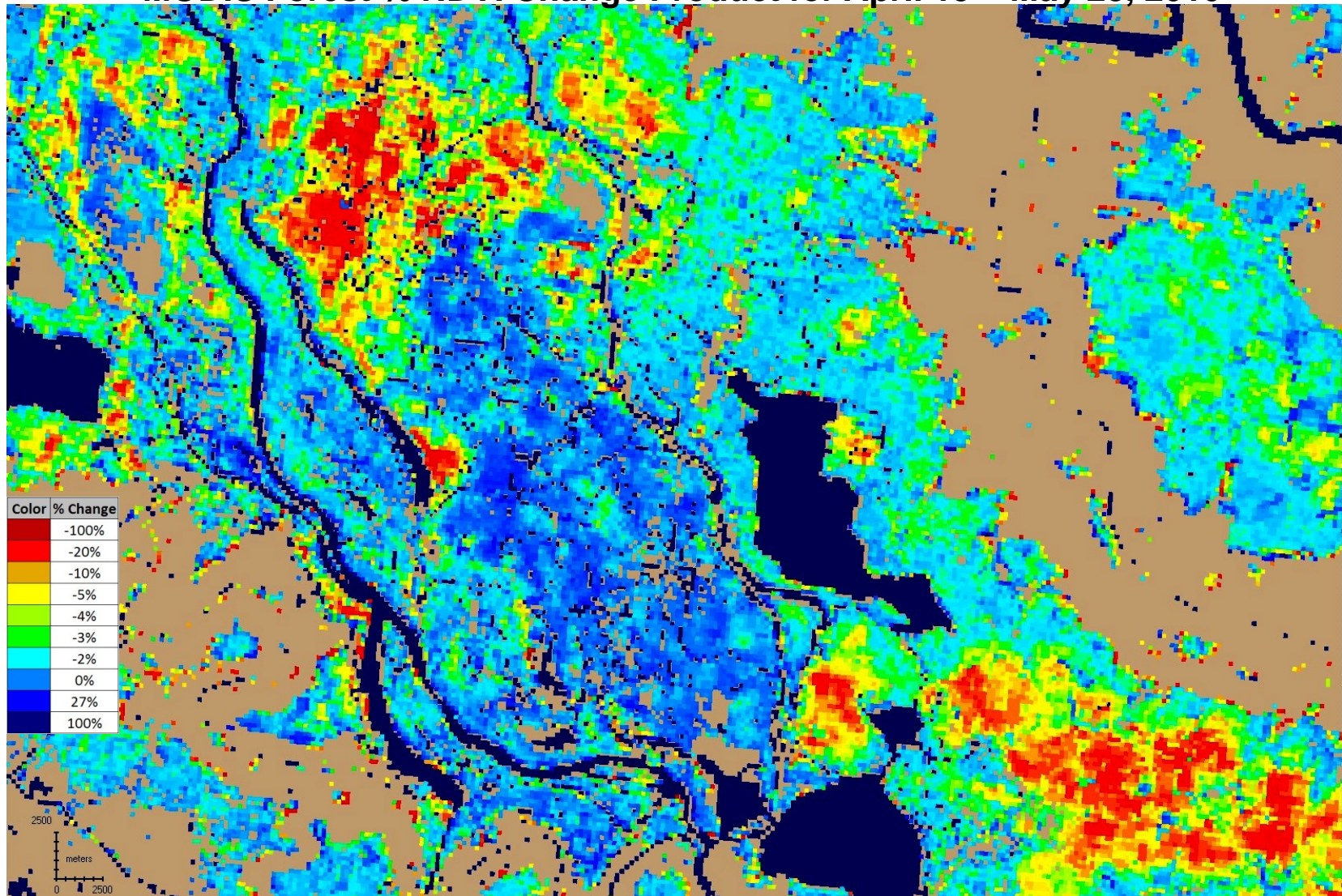
Series 3 – Swamp Forest Monitoring Products from MODIS NDVI Data

Landsat Forest Change Product Showing 2010 Insect Defoliation

Stennis Space Center



MODIS Forest % NDVI Change Product for April 15 – May 28, 2010

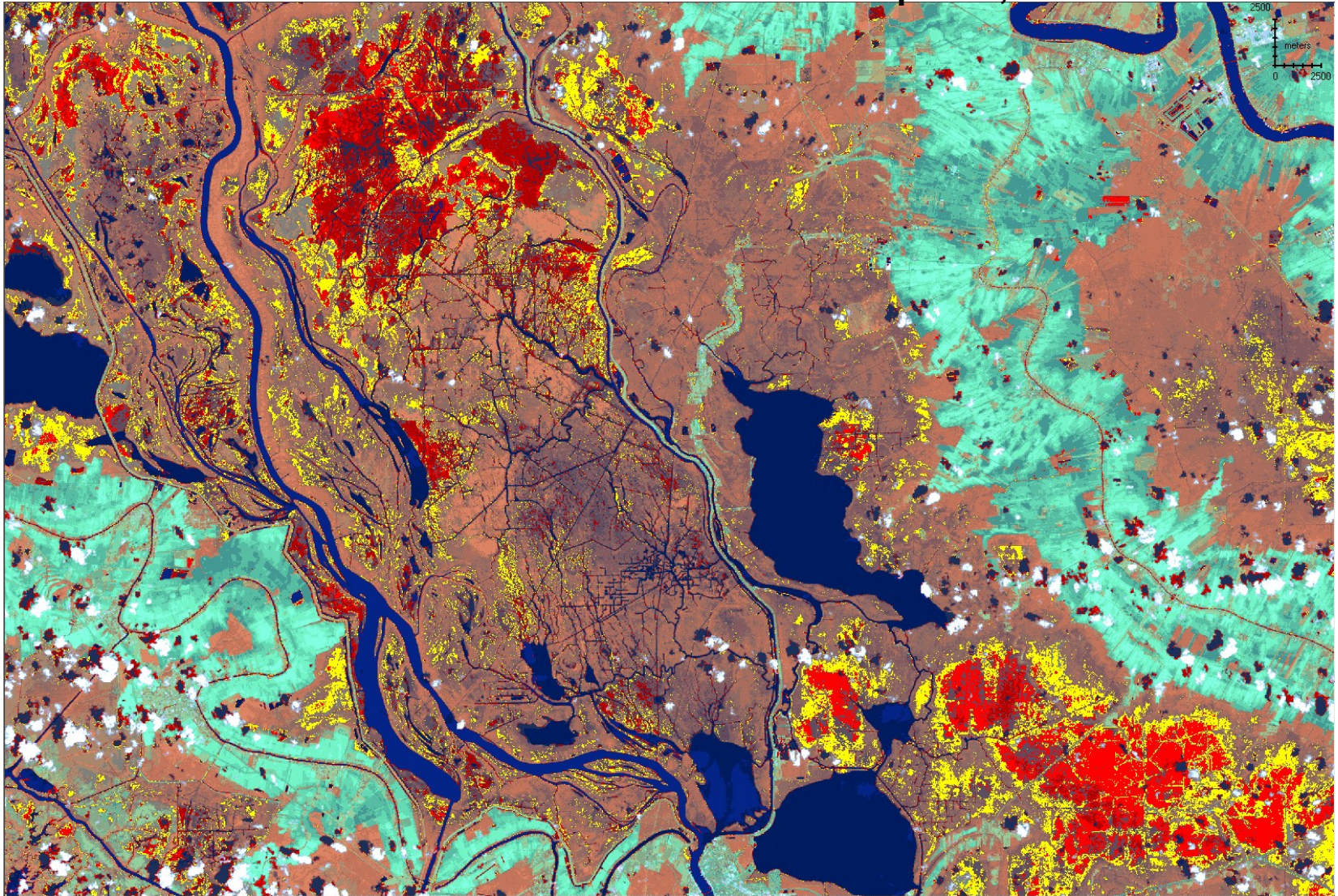


Landsat Classification of 2010 Insect Defoliation

Stennis Space Center



Landsat Defoliation Classification for April 21, 2010

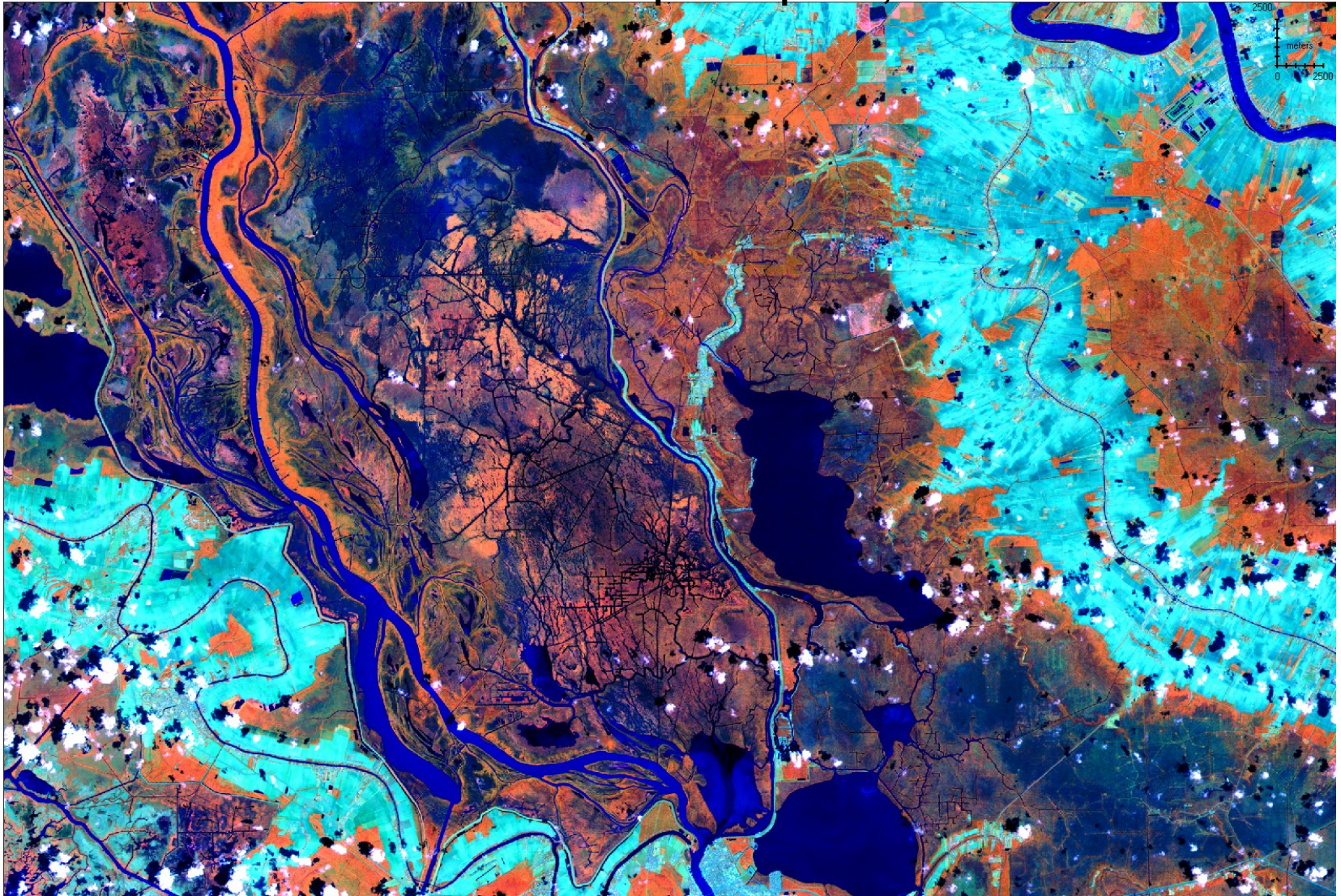


Landsat False Color Image of 2010 Insect Defoliation

Stennis Space Center



Landsat Data Acquired April 21, 2010

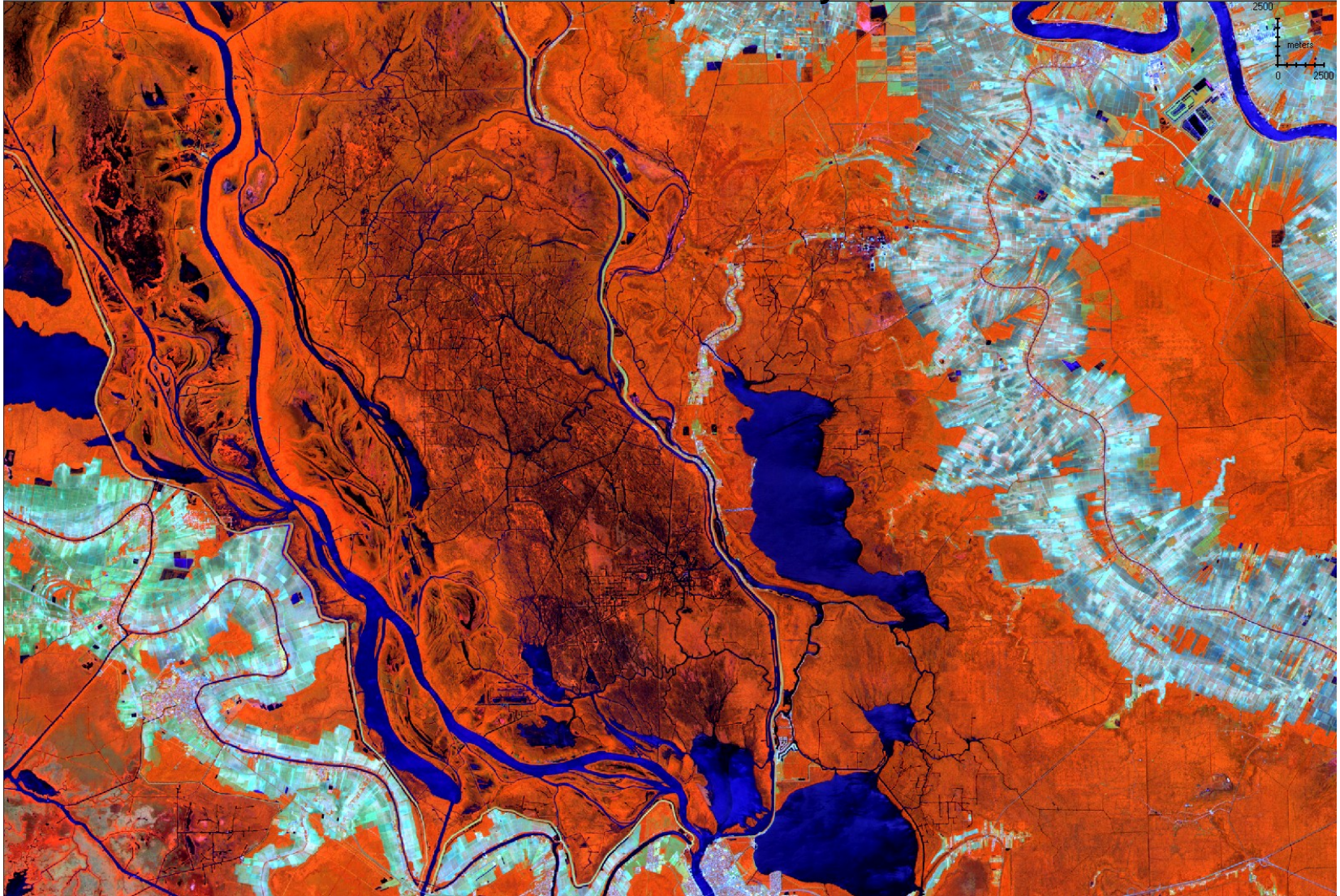


Landsat False Color Image of Same Area in Non-Defoliated State

Stennis Space Center



Landsat Data Acquired May 5, 2001



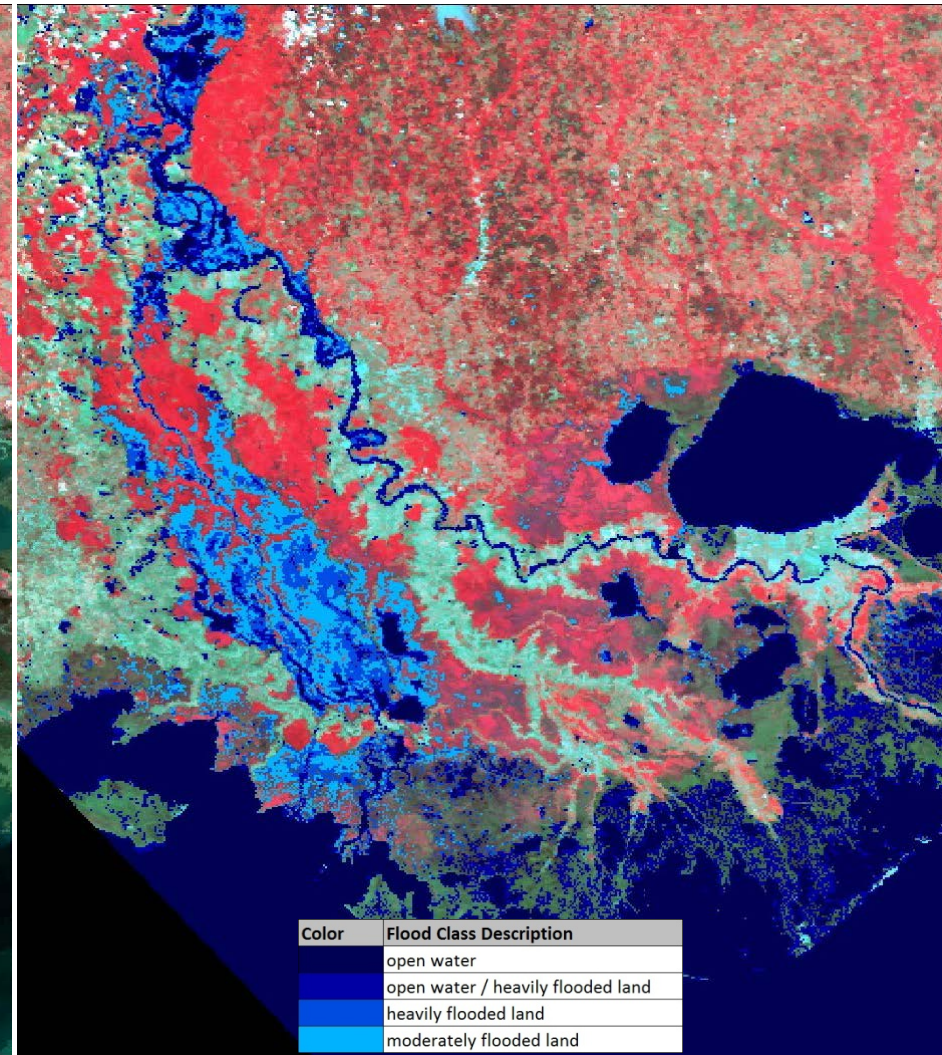
MODIS Map of 2011 Flooding During Morganza Spillway Release

Stennis Space Center



MODIS False Color Image from May 17, 2011

MODIS Wetland Flood Map for May 17, 2011

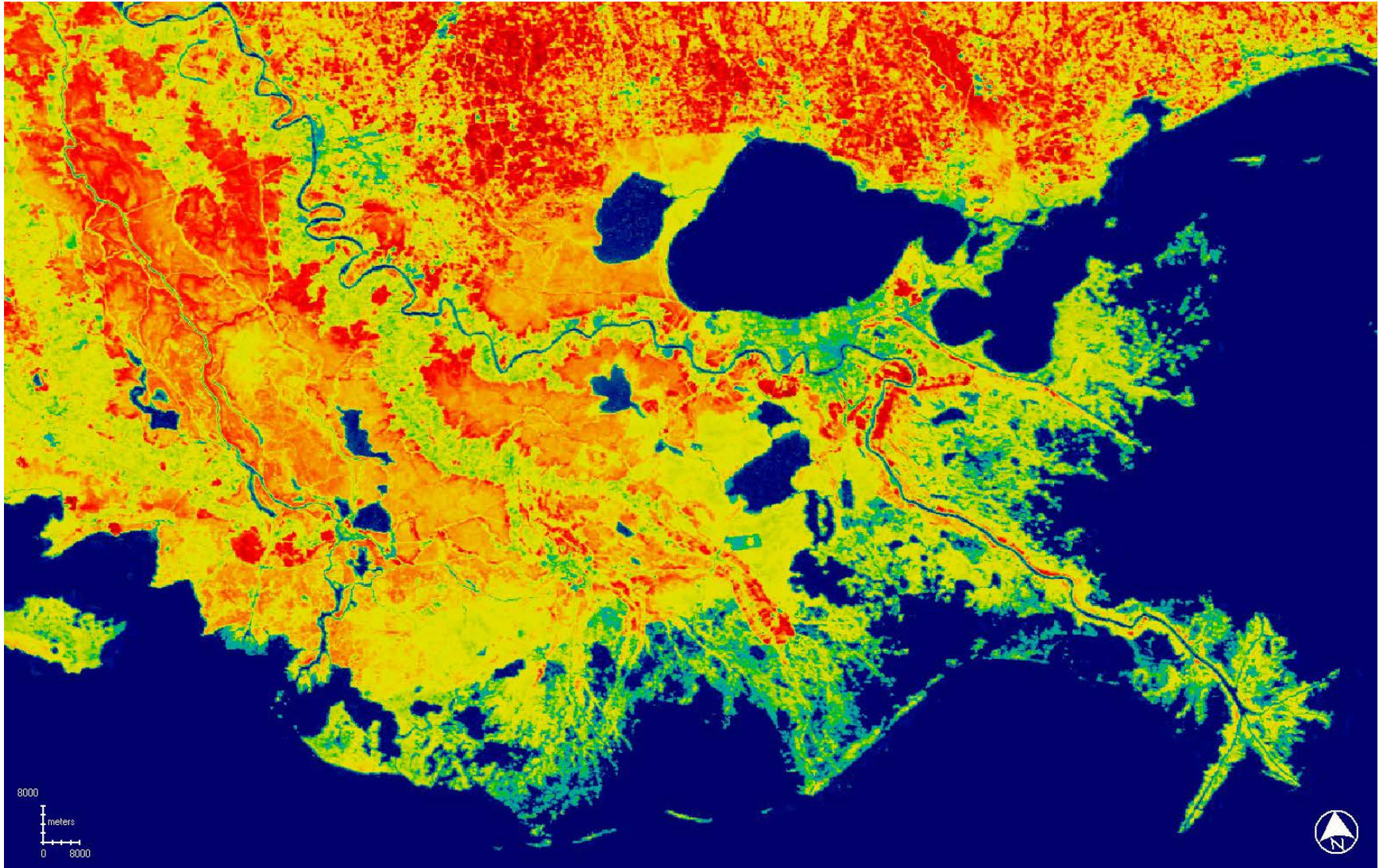


MODIS End of Year Cumulative NDVI for 2010

Stennis Space Center



Example Phenology Product with Potential for Monitoring Coastal Forest Health



Findings Thus Far



- Landsat classification of cypress type and canopy cover showed visual agreement to available reference data, though more work is needed to quantify accuracy
 - Areas with cypress concentrations were used to aid the CFCI evaluations for land acquisition and conservation easements
 - Percent cypress canopy cover may be helpful for showing where healthiest cypress stands are located
- ASTER data coverage was limited mostly useful for assessing Landsat and MODIS products
- Landsat swamp forest change products enabled assessment of disturbances occurring since 1972
 - Product detected harvesting and more ephemeral disturbances
- MODIS forest change products showed disturbances from storms, flooding, insect damage and large clearings

Final Remarks



- MODIS end of year cumulative NDVI products appear to have potential for assessing swamp forest health
 - Such products show real forest change, such as forest clearings
 - Such products also show relative variations in yearly canopy greenness “productivity”
- The main problem in doing the project was validation of the percent canopy cover product
 - Reference data acquisition was initially the issue but now resolved
 - Development of a reference product remains a challenge
- For more information on this presentation, email joseph.p.spruce@nasa.gov
- Weekly MODIS forest change products can be viewed on the US Forest Service ForWarn system on-line at: <http://forwarn.forestthreats.org/>



Participation in this work by Computer Sciences Corporation, Inc., was supported by NASA at the John C. Stennis Space Center, Mississippi, under contract NNS10AA35C. Work on this project was funded by a NASA ROSES grant (# NNX10AC57G, PI: Ellis).